data contributed by USGS/WRD. There are 14 fields associated with this data base and description of these fields is covered in the Description of Data Fields section. Once this data base was completed, the data were used for Geographic Information System (**GIS**) analysis and other statistical analysis. Plates and most figures in this report were created using Environmental Systems Research Institute Inc.'s GIS PC Arc/Info software.

Results and Discussion

The following section examines the data for the Snake-Payette Rivers Hydrologic Unit. The data from the previously mentioned sources were combined to create a single data base.

Pesticides

There are few existing pesticide data within the hydrologic unit. Due to cost, not many samples have been analyzed for pesticides within the hydrologic unit. The data used are from the following IDEQ studies: *Ground Water Quality Investigation in the Vicinity of Fruitland, Idaho* (IDEQ, unpublished); *Weiser Area Ground Water and Soils Monitoring Study* (Baldwin and Wicherski, unpublished); and *Ground Water and Soils Reconnaissance of the Lower Payette Area, Payette County, Idaho* (Baldwin and Wicherski, in prep.).

Within the hydrologic unit there have been 63 ground water samples analyzed for pesticides. Of these 63 ground water samples, there have been 41 detections of five different pesticide compounds from 30 different locations. Of these 41 detections, 29 are Dacthal (or acid metabolite), nine are Pentachlorophenol, one is 2,4-D, one is Diazinon, and one is Metribuzin (see table II). Sample locations of pesticide detections within the hydrologic unit are shown in Figure 8. Figure 8 represents each combination of the pesticides detected at a single location with a different symbol. Concentrations are not represented. The ranges of concentrations detected for the pesticides and their corresponding Maximum Contaminant Level (MCL) or Lifetime Health Advisory Level (HAL) for drinking water are included in Table III.

Table II. Pesticide data distribution.

name of contaminant	number of detections
Dacthal	29
PCP*	9
2,4-D**	1
Diazinon	1
Metribuzin	1
total	41

* Pentachlorophenol
** 2,4-Dichlorophenoxyacetic acid

From these data there are two major areas of pesticide concern. The western portion of the lower Payette river valley and the Sunnyside region south west of Weiser. Both areas are extensively farmed and furrow is the predominate form of irrigation. Common crops are corn, sugar beets, small grains, alfalfa, onions, and mint. Both areas are believed to have been impacted by non-point source pollution of the ground water from pesticides. There are not enough pesticide

Table III. Pesticide maximum contaminant levels.

Pesticide	Range µg/ℓ	MCL mg/ℓ	HAL µg/ℓ
Dacthal	0.040-98.5		3500
PCP*	TR-0.265	0.001	200
2,4-D**	0.380	0.07	70
Diazinon	TR		0.6
Metribuzin	TR		200

* Pentachlorophenol
** 2,4-dichlorophenoxyacetic acid

TR-Trace

MCLs from 1992 Code of Federal Regulations 40 parts 100 to 149. HALs from 1989 Health Advisory Summaries U.S. Environmental Protection Agency.

analyses available for drawing a conclusion that covers the entire area of the hydrologic unit. However, for the studies previously mentioned with areas sampled for pesticides within the hydrologic unit, pesticides were detected 65 percent of the time. Dacthal, a herbicide used for pre-emergent weed control was detected 46 percent of the time. Dacthal was frequently detected and is widely used within the hydrologic unit. In areas where furrow irrigation is common, it is likely that Dacthal is not being managed in the crop root zone. The hydrologic unit needs a comprehensive pesticide monitoring project to evaluate this pesticide and other contamination.

Nitrate

Chemicals are used intensively and extensively in the hydrologic unit. Fertilizer nitrogen use ranges between 29 and 297 lb/acre (Stieber, Stack, and Hutchison, 1992).

The following distinctions are made for the purpose of this assessment. Nitrate contamination occurs when nitrate concentrations exceed the background nitrate concentrations. The background nitrate concentration is the lowest concentration for a given area. The lowest nitrate concentrations from the hydrologic unit data set are the concentrations below the detection limit (BDL). An adverse trend in nitrate concentrations is defined in this report as occurring when nitrate concentrations exceed half of the drinking water standard. Therefore, concentrations above 5 mg/ℓ indicate the presence of an adverse trend that poses a threat to the beneficial uses of ground water.

The nitrate data set is 451 locations with nitrate values. The distribution of the concentrations is given in Table IV. A large percentage of the nitrate concentrations are below detection limits, which in most cases is 0.005 mg/ℓ. Figures 9,10 and 11 illustrate the nitrate concentrations in the hydrologic unit. Figure 9 shows sample locations and nitrate concentrations within the hydrologic unit.

Figure 10 is a nitrate concentration contour map. This computer-generated contour map was developed through a joint effort between IDEQ and USDA/SCS. The computer program GRASS, specifically the application *s.surf.idw,* was used to create the contour map. The application *s.surf.idw* fills a raster matrix with interpolated values generated from a set of irregularly spaced data points using numerical approximation (weighted averages) techniques. The interpolated value of a cell is determined by values of nearby data points and the distance of the cell from those input points. A line was manually inserted that shows areas of no data.

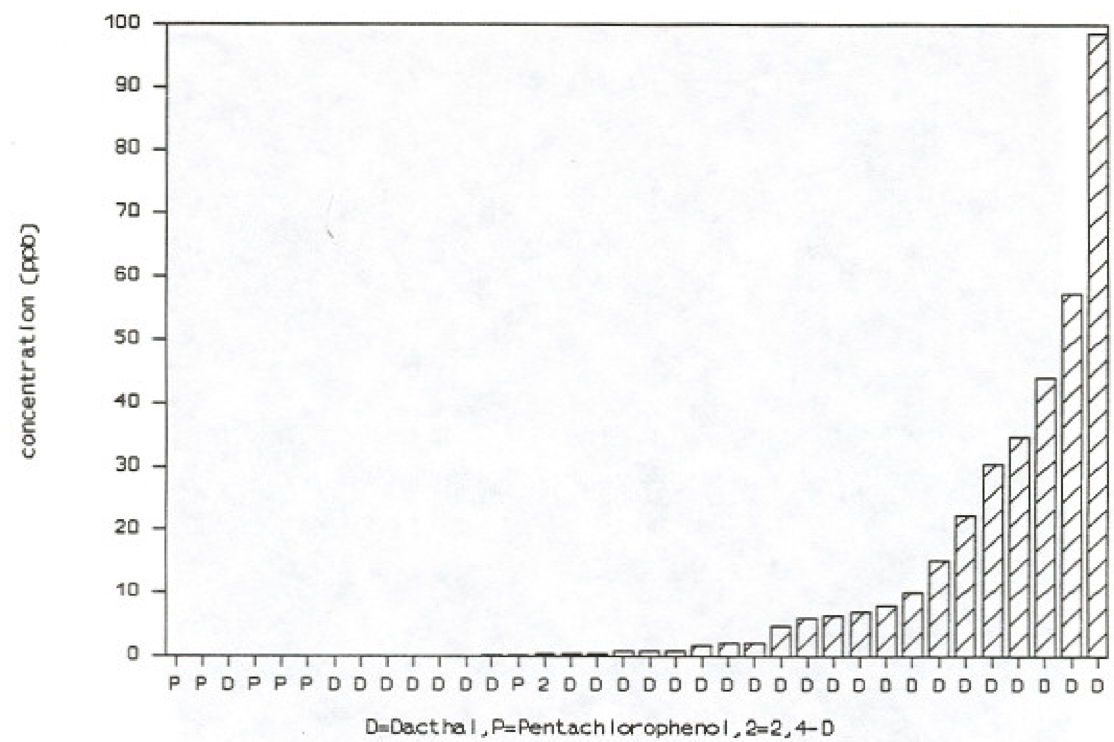

Figure 7. Distribution of pesticide concentrations in hydrologic unit.

Table IV. Nitrate data distribution

data range category	number of data
BDL	164
0-2 mg/ℓ	116
2-5 mg/ℓ	86
5-10 mg/ℓ	55
above 10 mg/ℓ	30
total	451

Figure 11 shows the percentile distribution of nitrate concentrations exceeding 5 mg/ℓ. This map was developed by evaluating the data relative to a grid and then by representing a mosaic of these evaluations. The grid was produced by using a network of same-sized equilateral triangles; every corner of each equilateral triangle touches the corner of five other equilateral triangles. The point at which six equilateral triangles meet, the point of intersection, is the point used to evaluate the data contained within the six triangles. Therefore, the data within a single equilateral triangle would be evaluated three times. Both the number of concentrations that exceeded 5 mg/ℓ within the six equilateral triangles and the total number of samples within the same six equilateral triangles were counted. The ratio of the number of concentrations exceeding 5 mg/ℓ, to the total number of concentrations would be the value stored at the point of intersection. The equilateral triangle size was determined so that no more than 50 locations would be within six connected equilateral triangles. The advantages to this type of map are unique. It shows areas that do not have enough data to evaluate; while it also treats high density data distribution areas and low density data distribution areas indifferently. A disadvantage is that a single high concentration in an area of medium density data can give the impression that the area has widespread contamination. Figure 11 has several of these areas in the northeast quadrant of the hydrologic unit. The areas that accurately depict contamination occur where there is a gradual change in percent of data above 5 mg/ℓ nitrate. The data indicate several areas of nitrate concern. Sunnyside and the western half of the lower Payette River valley exhibit an adverse trend in nitrate concentrations. Also, much of Canyon County that is within the hydrologic unit exhibits an adverse trend in nitrate concentrations.

There are some areas exhibiting adverse trends in nitrate concentrations in the northeast quadrant of the hydrologic unit. Most of this area is open range and is used for raising stock by residents in the area. When the animals are kept in these stock yards there is a possibility for the wells to be contaminated. This practice or other waste disposal practices may be responsible for the adverse trends in nitrate concentrations in the northeast quadrant of the hydrologic unit.

Vulnerability

The potential, relative vulnerability of ground water to contamination can be used to select areas of possible contamination. Vulnerability has been determined for some of the areas within the hydrologic unit through the *Idaho Ground Water Vulnerability Project* (Rupert et. al., 1991). This project used a modified form of DRASTIC (Aller et. al. 1985), which was developed by the National Water Well Association under contract to the U.S. Environmental Protection Agency. The DRASTIC model evaluates the ground water pollution potential of a given hydrogeologic setting based on a set of defined characteristics, along with ratings or "weights" assigned to those characteristics. The Idaho Ground Water Project used three layers that resemble those used by DRASTIC (depth-to-water, soils, recharge), but these differ from DRASTIC in that they use different sources of information, a finer scale, and a different rating scheme (Rupert et. al., 1991).

Figure 13 is a map of ground water vulnerability within the hydrologic unit. The source of the GIS coverage was the final ground water vulnerability layer, from the Idaho Ground Water Vulnerability Project. Note that vulnerability data do not exist for the portion of the hydrologic unit that extends into Oregon.

The areas along the Payette River, the Boise River, and the Snake River show the greatest vulnerability to contamination. These areas include Sunnyside, lower western Payette River valley, and northeastern Canyon County.

Based upon the data observed in the hydrologic unit, it is evident that the

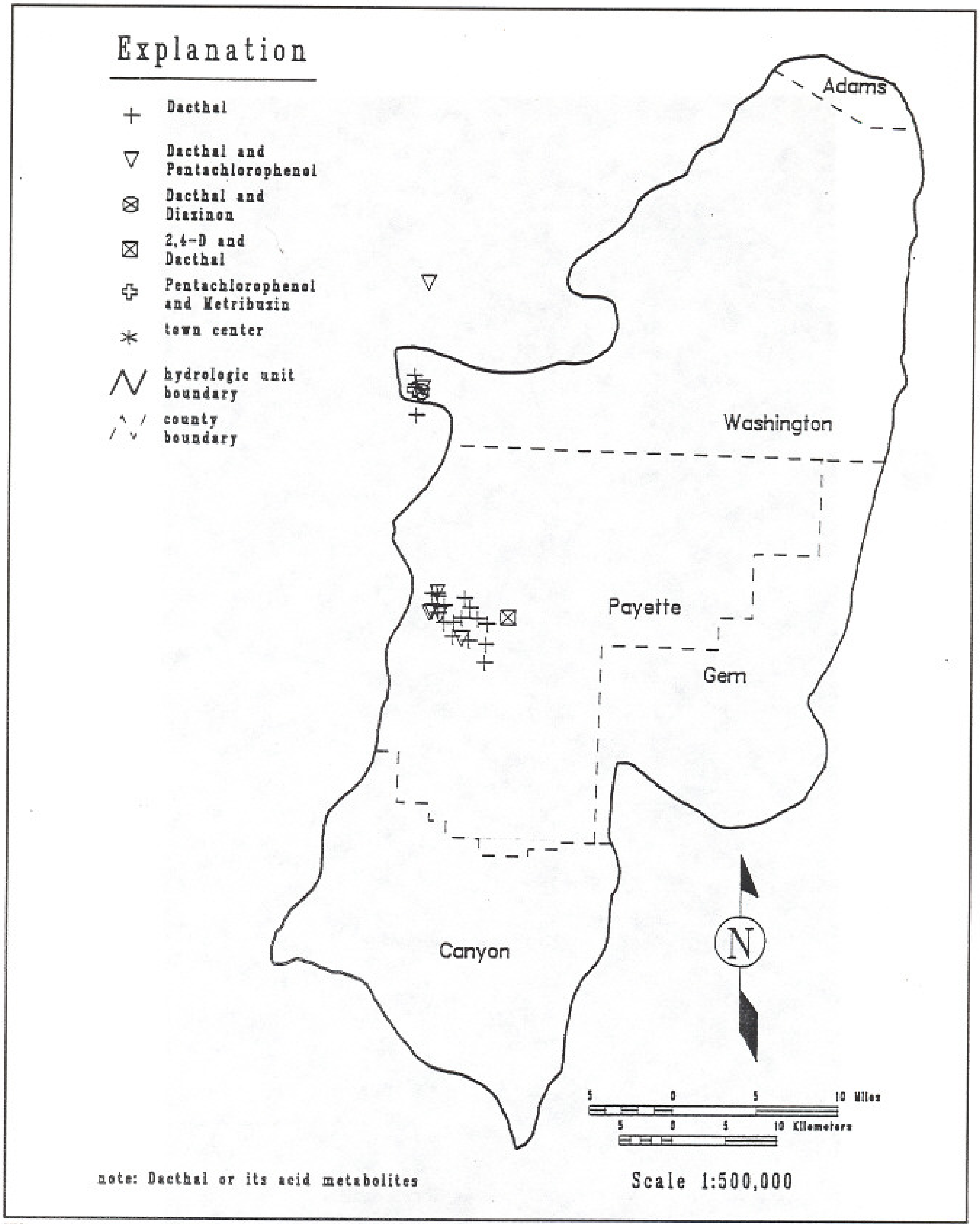

Figure 8. Sample location of pesticide detection within the hydrologic unit.

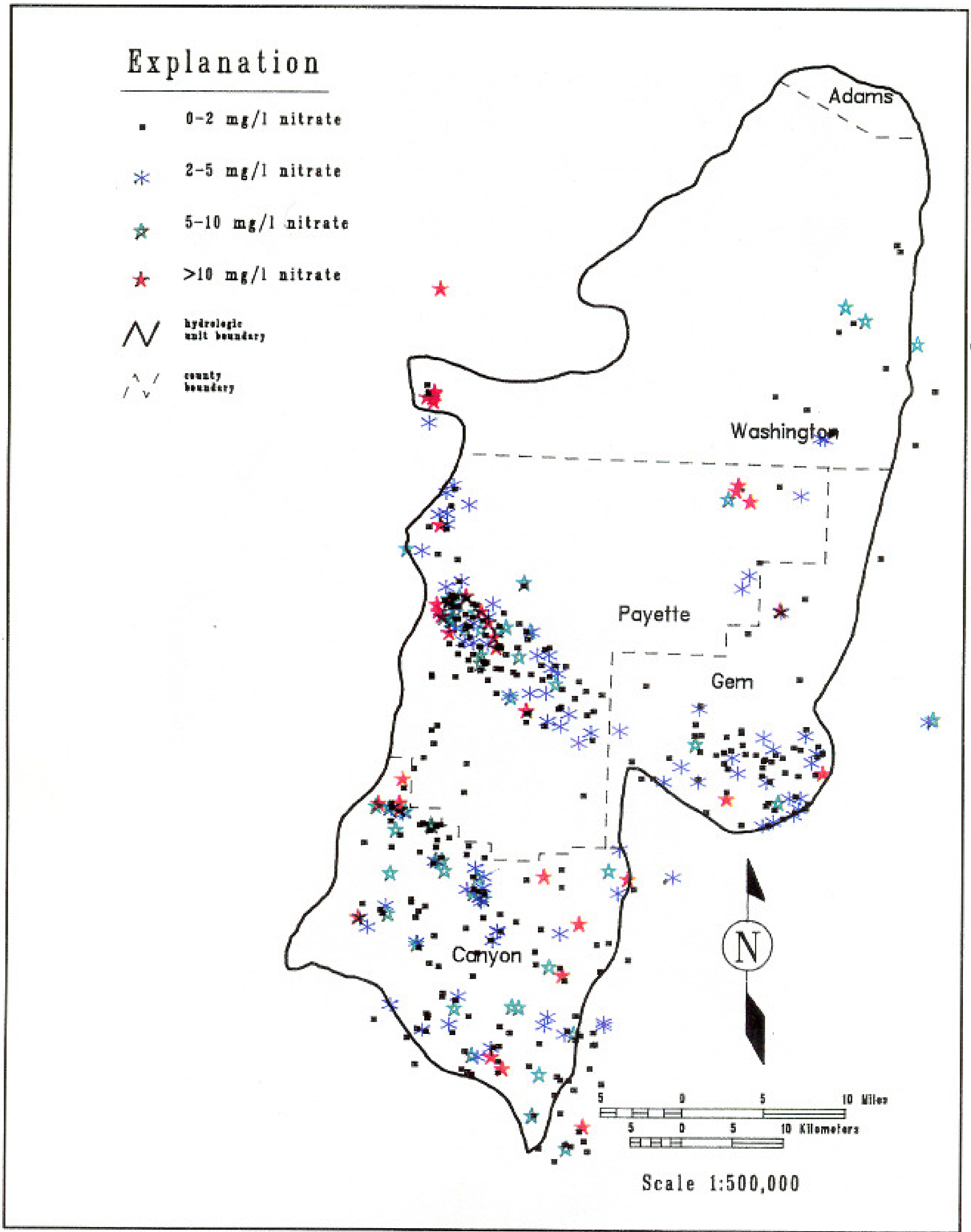

Figure 9. Sample location and nitrate concentrations within the hydrologic unit.

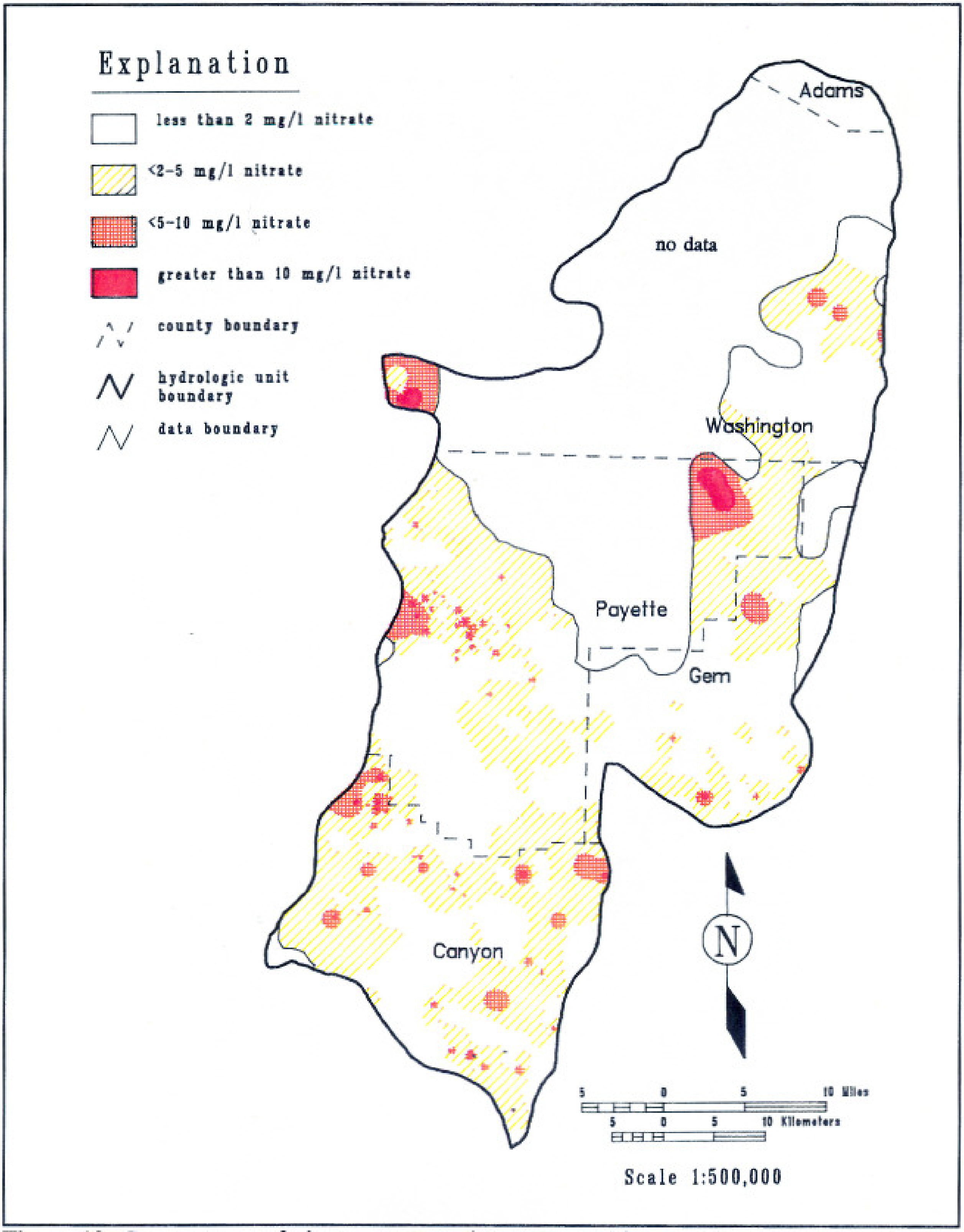

Figure 10. Contour map of nitrate concentrations measured in ground water.

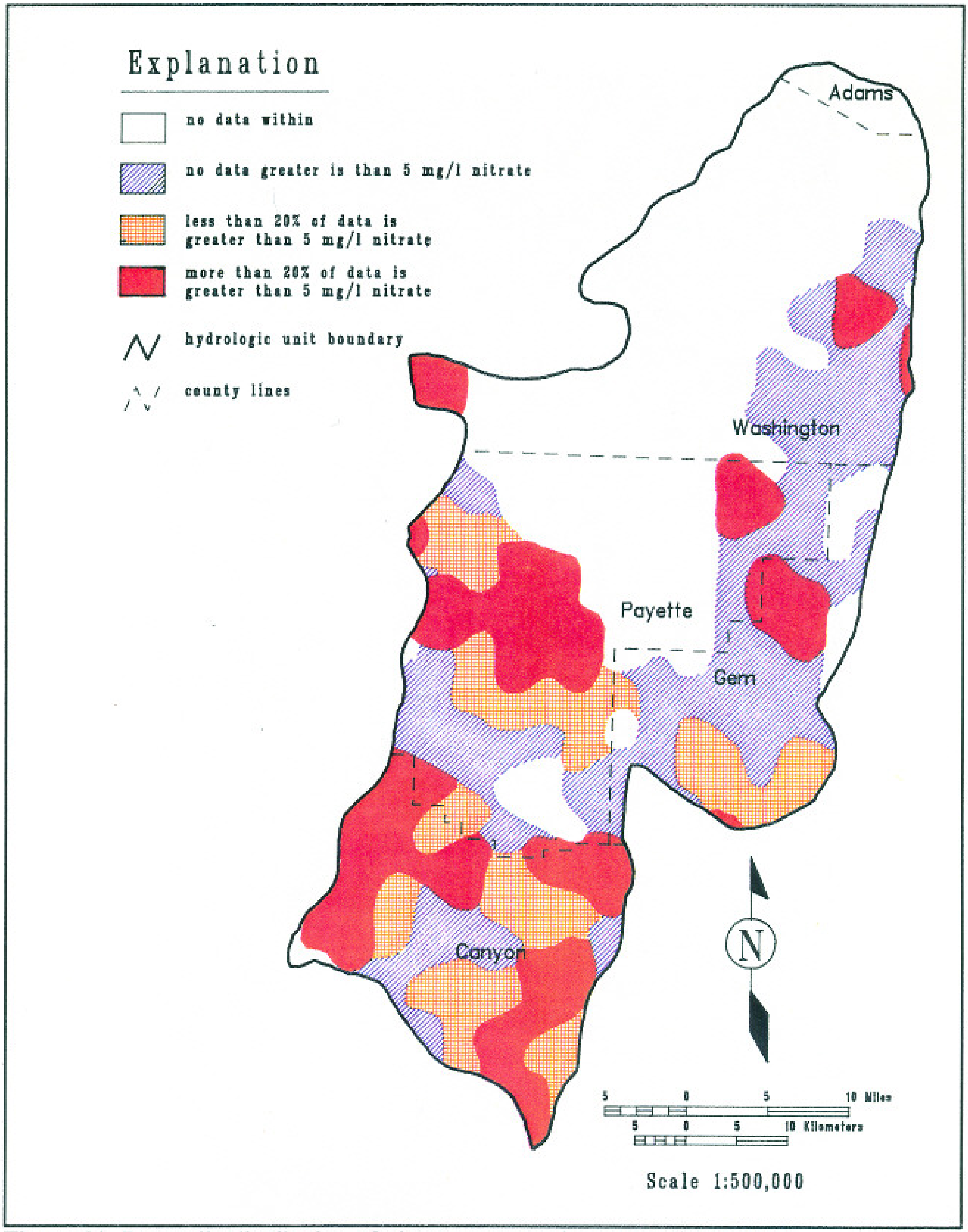

Figure 11. Percentile distribution of nitrate concentrations exceeding 5 mg/ℓ.

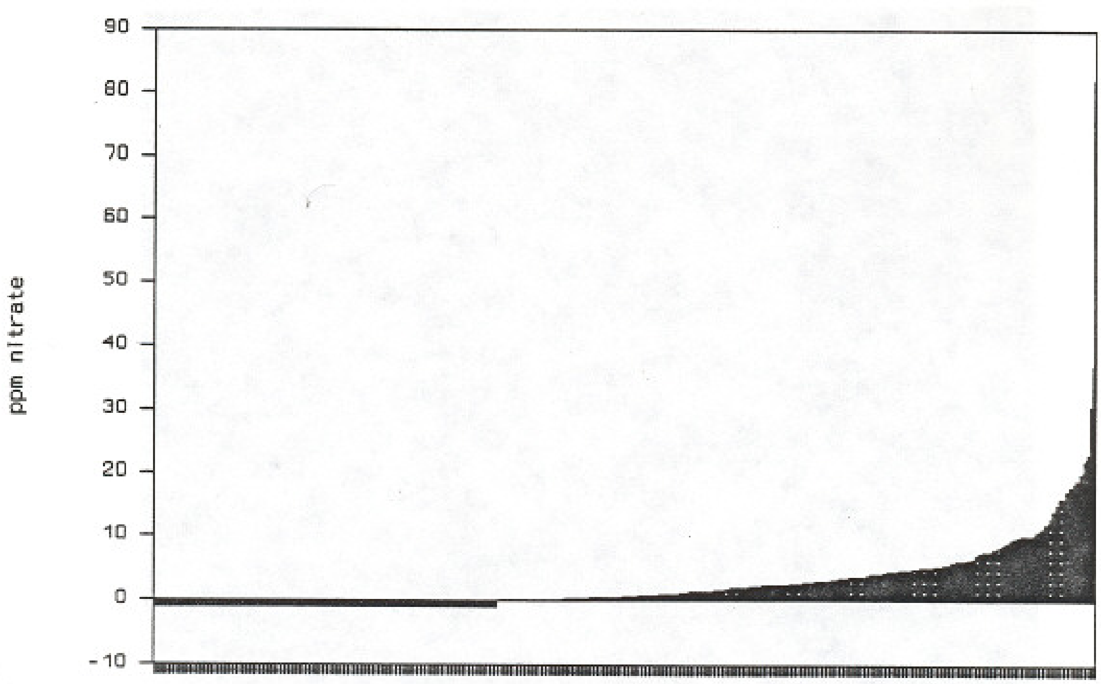

Figure 12. Distribution of nitrate concentrations in hydrologic unit.

vulnerability mapping is a valid tool for selecting areas that may be suitable for implementing nonpoint source pollution control mechanisms. Out of a data base consisting of 451 samples, only one of the samples that had nitrate concentrations above 10 mg/ℓ was located within low and moderate vulnerability rated areas.

Conclusions

From the results generated by this study of the pesticide, nitrate, and vulnerability data, the critical areas of the non-point source pollution of ground water within or proximal to the hydrologic unit are located in the western portion of the lower Payette River valley, most of the portion of Canyon County that is within the hydrologic unit, and the Sunnyside area, south of Weiser. The western portion of the lower Payette River valley's ground water has pesticide contamination. Greater than 20 percent of the wells in this area are above 5 mg/ℓ nitrate, and the area has been shown to be very vulnerable to ground water contamination. The area exhibits extensive agricultural activities. Ground water quality impacts from intensive crop production provides a likely